THE LARVA OF *DIADOXUS ERYTHRURUS* (WHITE) (COLEOPTERA: BUPRESTIDAE)

By T. J. Hawkeswood
49 Venner Road, Annerley, Brisbane, Queensland, 4103

Abstract

The larva of *Diadoxus erythrurus* (White) is described from material collected from the Dunmore State Forest, south-east Queensland. Comparisons are made with previously described buprestid larvae from Australia [*Prospheres aurantiopicta* (Laporte & Gory) and *Pseudotaenia waterhousei* (Van de Poll)].

Introduction

The general biology of *Diadoxus erythrurus* (White) and *D. scalaris* Laporte & Gory was recently reviewed by Peterson and Hawkeswood (1980). The beetles of this genus are commonly known as cypress pine jewel beetles since they are destructive borers of cypress pine (*Callitris* spp.) and introduced *Cupressus* spp. (Cupressaceae) throughout Australia (Froggatt, 1907; French, 1911; Hadlington and Gardner, 1959; Peterson and Hawkeswood, 1980; Hawkeswood and Peterson, 1982).

The larvae of Australian Buprestidae are poorly known (Hawkeswood and Peterson, 1982) with only the larvae of *Prospheres aurantiopicta* (Laporte & Gory) (Levey, 1978a) and *Pseudotaenia waterhousei* (Van de Poll) (Hawkeswood, 1984) being described in any detail.

Diadoxus erythrurus (White) is perhaps the most economically important Australian buprestid, yet the larva has remained undescribed and the genus is in need of revision. An opportunity to describe the larva recently arose when Messrs M. De Baar and M. Hockey collected live material from the Dunmore State Forest, south-eastern Queensland (*c.* 27°40′S, 150°50′E).

The terminology used for the larval description generally follows that of Benoit (1964, 1966), Bily (1972, 1975a, 1975b) and Hawkeswood (1984).

Description of larva

(Figs 1-10)

Length of last instar 17.0-24.0 mm (mean 19.9), width of the prothorax 4.0-5.2 mm (mean 4.6), width of abdomen 2.2-3.0 mm (mean 2.4). Larva is of the usual buprestid type with an enlarged prothorax into which the head capsule is retracted. Body dark cream to pale orange-yellow in colour, apodous, very weakly sclerotized except for mandibles, epistome, hypostome and spiracles. Epistome and hypostome reddish-brown, strongly sclerotized. Body almost glabrous except for a lateral pubescence of sparse, posteriorly directed hairs on the lateral margins of head, thoracic segments and abdomen and some moderately dense patches of microtrichiae on head.

Head and mouth parts

Epistome (Fig. 2): about 3.8-4.0 times wider than long; anterior margin weakly bisinuate between the mandibular condyles which are large; posterior margin almost straight between the lateral tentorial pits; epistome bearing two, very small, sensory areas (epistomal sensory pits) in the middle. Clypeus (Fig. 2) narrow, membranous, glabrous, dark cream to yellow in colour, about 2.4-2.6 times wider than long, collar-shaped, anterior margin straight. Labrum (Figs 2, 4, 5) pale brown, mostly membranous (weakly sclerotized in some areas); about 1.0-1.2 times wider than long; anterior margin arcuate between prominent rounded lateral lobes; with a fringe of dense, short, stiff setae along the anterior margin and a wider fringe of similar setae on the lateral lobes.

Labrum dorsally (hypopharnyx) with the following setae on either side: one moderately long, sharp seta near the anterior margin of the lateral lobe; a similar seta almost half the distance from the lateral margin to the midline and a slightly longer, sharp seta on the lateral margin about half the distance from the lateral lobe to the anterior margin of the clypeus; ventral surface (epipharynx) with three short, blunt, stiff setae on the lateral lobes just below the anterior margin and a dense covering of short, stiff, sharp setae on most of the epipharynx extending to the lateral lobes.

Antennae (Fig. 7): 3-segmented; 1st segment broadly cylindrical, about 1.1 times longer than wide, with a dense, broad fringe of short, stiff, sharp spines on anterior margin; 2nd segment about 0.8-1.0 times longer than wide, with a dense, broad fringe of short, stiff, sharp spines on the anterior margin and a very long, sharp seta situated a short distance behind apex near external lateral margin; apex of 2nd segment shallowly concave, encircling the 3rd segment which is very small and peg-shaped without spines; 1st segment is situated on a non-sclerotized segment bearing sharp spines.

Mandibles (Fig. 6): black, with two teeth at apex and a sub-apical tooth on the dorso-lateral margin.

Hypostome (Fig. 3): moderately sclerotized; posterior margin slightly arcuate.

Labio-maxillary complex (Fig. 3): maxillary basis (cardo) membranous, fused to the labium, glabrous except for a single, anteriorly directed seta situated on a strongly chitinized sensory area near external posterior angle; stipes moderately sclerotized, glabrous except for a dense fringe of short, spines along anterior and internal lateral margins and a very long, anteriorly directed seta, close to anterior margin near midline. Maxillary palpus (Figs 3, 8): 2-segmented; basal segment about 1.2-1.5 times longer than apical segment, glabrous except for a fringe of short spines on anterior margin and a moderately long, anteriorly directed, sharp seta on external anterior angle. Mala slightly longer than the basal segment of maxillary palpus, with three moderately long, sharp setae at apex and two short, blunt spines on internal lateral margin below anterior margin; anterior margin with a fringe of short, stiff spines. Labium (Fig. 3) pale brown, mostly membranous; prelabium about 2.0 times wider than long; external anterior angle broadly rounded; anterior margin with a broad fringe of short, fine spines; post-labium glabrous, smooth, except for a short, sharp sensory seta situated on a prominently sclerotized area about half way from the lateral margin to midline; labial palpi absent.

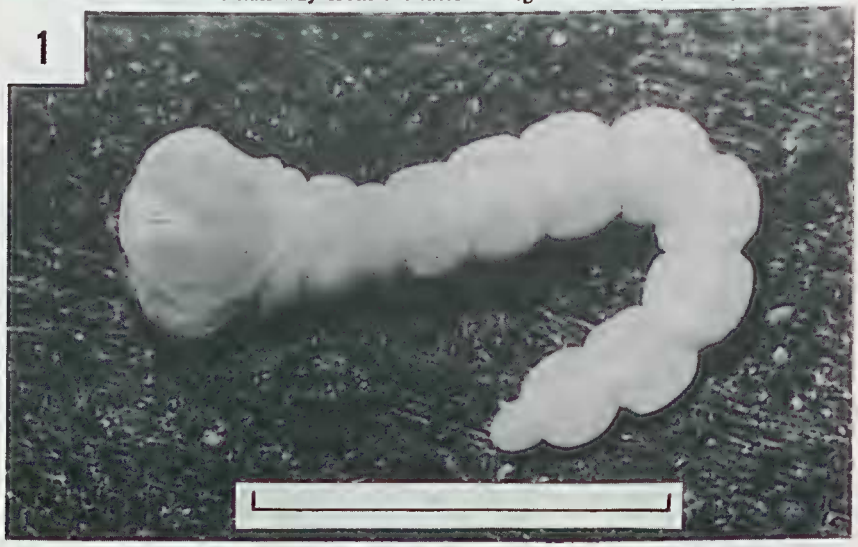
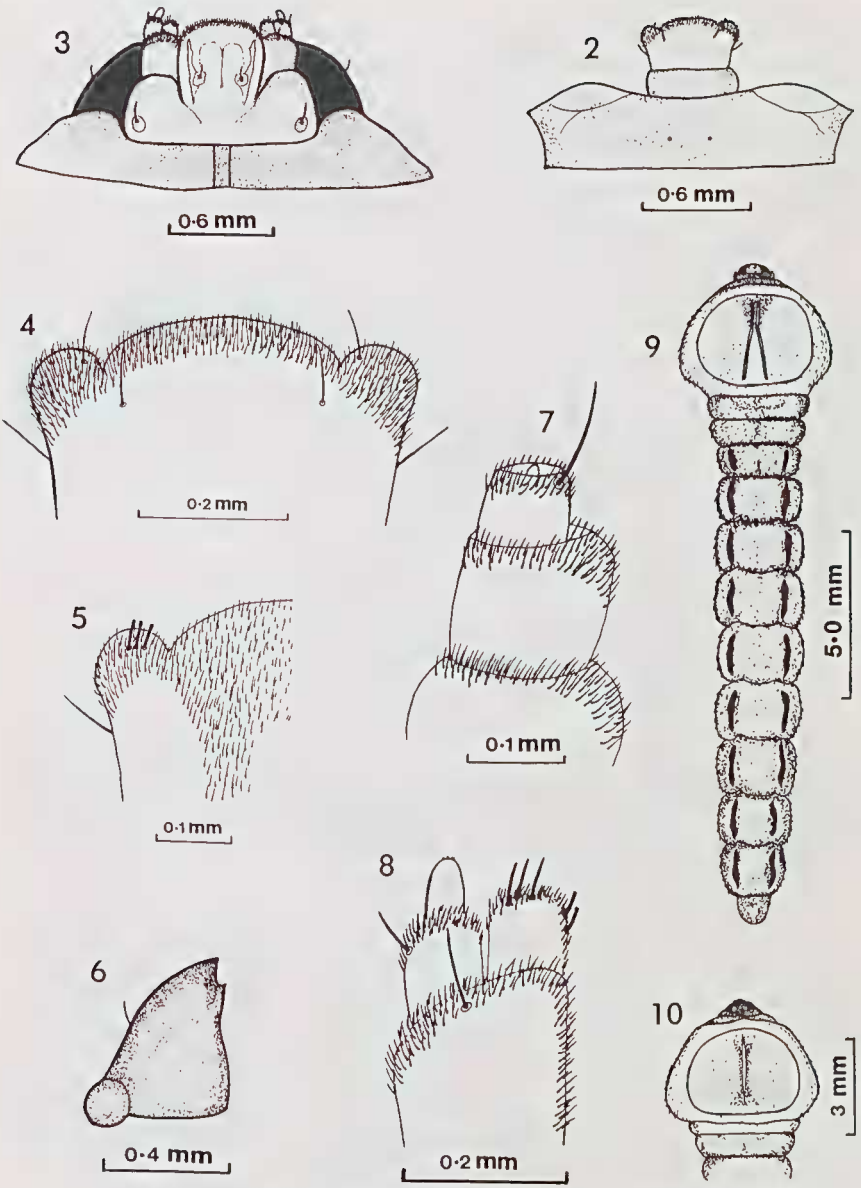


Fig. 1. Larva of *D. erythrurus*. (Scale line = 10 mm).



Figs 2-10. Larva of *D. erythrurus*: (2) epistome, clypeus and labrum; (3) hypostome and labio-maxillary complex; (4) dorsal surface of labrum (hypopharynx) showing arrangement of short, stiff setae and longer setae; (5) ventral surface of half of labrum (epipharynx) showing arrangement of short, stiff setae and blunt spines; (6) left mandible; (7) antennae; (8) stipes, maxillary palp and mala; (9) dorsal view showing thoracic and abdominal segments; (10) ventral view showing thoracic segments.

Thorax

Pro-, meta-, and mesothorax dark cream in colour, without rudiments of legs (see Bily, 1972; Hawkeswood, 1984), mostly glabrous except for a few short, sharp, posteriorly directed setae on lateral margins (Figs 9, 10). Prothorax (Figs 9, 10) 1.8-2.0 times wider than long; dorsal plate with two, well-defined median grooves coalescing anteriorly forming an inverted V-shaped groove then extending almost parallel a short distance, not completely dividing the plate (Fig. 9), whole surface densely covered in orange-brown micro-granules, becoming slightly reticulate towards anterior margin of plate; ventral plate with a single, median groove almost dividing plate (Fig. 10), showing a reticulate pattern of small, dense, orange-brown micro-granules adjacent to the groove in the midline; both plates impunctate, not finely and longitudinally rugose. Mesothorax about 3.0 times wider than long; spiracles narrow and reniform in shape, 0.8-1.0 mm long. Metathorax about 2.5-2.8 times wider than long, without spiracles; ambulatory pads not well developed.

Abdomen

Abdominal segments (Figs 1, 9): cream to yellow in colour; 1st segment about two-thirds width of mesothorax (about 2.0 times wider than long), slightly narrower than the other segments, without ambulatory pads; segments 2-6 of similar size, segments 7-9 becoming progressively smaller, segment 10 the smallest, conical in shape, without paired sclerotized structures. Spiracles broadly reniform in shape, 0.3-0.4 mm long. Thoracic and abdominal segments 1-10 clothed laterally with a few, sparse, usually posteriorly directed, sharp, fine setae.

MATERIAL EXAMINED: 6, Brisbane, ex. sawn timber of *Callitris columellaris* F. Muell. (Cupressaceae), 17 April 1975, "Mikes Supp." (QDF); 3, Dunmore State Forest via Dalby, ex. log billets of *Callitris columellaris* F. Muell., em. 10 Jan. 1982, coll. R. A. Yule, M. Hockey and M. De Baar (QDF).

The record of *C. columellaris* as a larval food plant for *Diadoxus erythrurus* has been previously recorded by Hawkeswood and Peterson (1982).

Discussion

There has been much controversy over the higher classification of the Buprestidae, the main arguments arising from comparative studies of adult morphology. Few systematic studies have been made of larval taxonomy but those that have been completed (e.g. Bily, 1972, 1975a, 1975b; Volkovitsh, 1979), showed important characters separating taxa both at the generic and specific levels.

According to Thery (in Carter, 1929), the genus *Diadoxus* belongs to the subfamily Chalcophorinae (tribe Chalcophorini) along with *Cyria, Cyrioxus, Cyphogastra, Chrysodema, Pseudotaenia, Paracupta, Chalcotaenia* and *Iridotaenia.* However, Levey (1978b) suggested that *Diadoxus, Cyria* and *Cyrioxus* should be included in the tribe Epistomentini (of Chalcophorinae ?) on the basis of adult morphology and stated that the Chalcophorini appeared to be a polyphyletic group. Since all possible evidence is needed to provide a better understanding of their taxonomy, it was hoped that a detailed study of the *Diadoxus* larva may assist by providing comparative data and more characters to be used in taxonomic considerations of closely related groups.

A comparison of the larvae of the only three Australian buprestid species described to date is provided in Table 1, using characters I consider to be of importance in larval taxonomy. Of the 16 characters listed, *Pr. aurantiopicta* shares only two of these with *D. erythrurus* (i.e. similar size and seta on 2nd antennal segment long) and only three with *Ps. waterhousei* (i.e. presence

of well-developed ambulatory pads, presence of rudimentary legs, and hypopharynx with four long setae). Using a simple matching coefficient of similarity, a value of 0.12 is obtained between *Pr. aurantiopicta* and *D. erythrurus* and 0.21 between *Pr. aurantiopicta* and *Ps. waterhousei*, indicating, in both cases, a marked dissimilarity between the respective taxa.

On the basis of adult morphology, the status of *Pr. aurantiopicta* in the Polycestinae (Polyctesini) appears valid at this stage, although its larva does not appear to have any affinities with those of *Acmaeoderella* (Volkovitsh, 1979) or *Ptosima* (Bily, 1972), both of which are also placed in the Polycestinae (Bily, 1977).

Diadoxus erythrurus and *Ps. waterhousei* show a closer relationship than between either species and *Pr. aurantiopicta*. They share seven of the 16 characters listed in Table 1, giving a similarity coefficient of 0.44. However, this value is too low to support the retention of *D. erythrurus* in the Chalcophorinae with *Pseudotaenia* as originally proposed by Carter (1929). At present, *D. erythrurus* must remain in the Epistomentini as suggested by Levey (1978b), although no other Epistomentini larvae have been described for comparison.

The larva of *D. erythrurus* appears to be somewhat intermediate between those of *Pr. aurantiopicta* and *Ps. waterhousei*, sharing some characters with

TABLE 1
Comparison of main taxonomic characters between the larvae of *Prospheres aurantiopicta* (Laporte and Gory), *Diadoxus erythrurus* (White) and *Pseudotaenia waterhousei* (Van de Poll)

Pr. aurantiopicta	*D. erythrurus*	*Ps. waterhousei*
* Body length 21-27 mm	Body length 17-24 mm	Body length 68-87 mm
Wide epistome: length/width ratio = 5.0:1.0	Narrow epistome: l/w ratio = 3.5:1.0	Narrow epistome: l/w ratio = 3.5:1.0
Labrum with shallow lateral lobes and biarcuate anterior margin	Labrum with rounded lateral lobes and slightly arcuate anterior margin	Labrum with prominent rounded lateral lobes and arcuate anterior margin
Hypopharynx with 4 long setae	Hypopharynx with 3 long setae	Hypopharynx with 4 long setae
Mandibles with 5 teeth and a large rugose boss on the external face	Mandibles with 3 teeth and a smooth external face	Mandibles with 4 teeth and a smooth external face
† Antennae with spines on apex of 2nd segment only	Antennae with spines at the apex of 1st and 2nd segments	Antennae with spines at the apex of 1st and 2nd segments
Seta on 2nd antennal segment long	Seta on 2nd antennal segment long	Seta on 2nd antennal segment short
Last antennal segment elongate	Last antennal segment short	Last antennal segment short
Mala with 2 sharp setae and 6 blunt spines	Mala with 3 sharp setae and 2 blunt spines	Mala with 4 sharp setae only
Maxillary palpus (1st segment) with one sharp and one blunt spine	Maxillary palpus with no spines or setae	Maxillary palpus with no spines or setae
One groove on dorsal thoracic plate	Two grooves on dorsal thoracic plate	Two grooves on dorsal thoracic plate
Anterior margin of labium biarcuate	Anterior margin of labium arcuate	Anterior margin of labium arcuate
Setose elevations absent from labium	Setose elevations absent from labium	Setose elevations present
Rudimentary legs present	Rudimentary legs absent	Rudimentary legs present
Ambulatory pads well developed	Ambulatory pads poorly developed	Ambulatory pads well developed
Dorsal and ventral prothoracic plates showing a reticulate pattern of micro-granules either side of median grooves	Dorsal plate densely covered with randomly distributed micro-granules; ventral plate with reticulate pattern of micro-granules either side of median grooves	Dorsal and ventral plates with randomly arranged conical asperities

* Levey (1978a) did not provide measurements of the larva nor scales on his drawings of the larva (Figs 9, 10). The dimensions provided above were taken from the following material housed at the Department of Forestry, Brisbane: 3, Kandanga, 17 July 1974, R. A. Yule and F. R. Wylie, "ex sawn and stacked 8 month hoop pine".

† Levey (1978a) regards the antennae of *P. aurantiopicta* as 4-segmented, but according to Bílý (1982, pers comm.) the antennae of almost all Buprestidae are 3-segmented, and the basal or "1st segment" may be regarded as part of the epistome, since it is membranous and differs from the true antennal segments by not being sclerotized.

either species (e.g. microgranules on the prothoracic plates as in *Pr. aurantiopicta*, and two grooves on the dorsal thoracic plate as in *Ps. waterhousei*), but possessing some characters not found in either taxon (e.g. mandibles with 3 teeth) (Table 1).

Morphological studies of buprestid larvae are still in their infancy in Australia but study of further species should benefit contemporary studies dealing with adult morphology and taxonomy because of the complexity of the larvae so far examined and the multitude of characters to utilize.

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